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(54) Quick-coupling device for attaching tools to an excavator

(57) Quick-coupling device for attaching a tool (2) to an excavator comprising at least one main working arm (1); this device comprises a main body (3) provided with two side walls (306) each connected at the rear to this working arm (1) by a pin (401) housed in holes (301) in these walls (306) to allow it to be rotated relative to the said arm (1) by the movement of excavator levers (5) connected to the body (3) by a pin (40) housed in holes (302) in these walls (306) and at the front to upper walls (205) of this tool (2) by second pins (7) for locking them onto this tool (2); and these second pins (7) are able to extend out of these side walls (306) and be housed in holes (204) formed in these upper walls (205) of the tool (2) under the action of control means (8) mounted in this body (3) for automatically inserting and removing them into and from these holes (204), these upper walls (205) being provided with rear hook means (203) for attaching the tool (2) to pins (4).

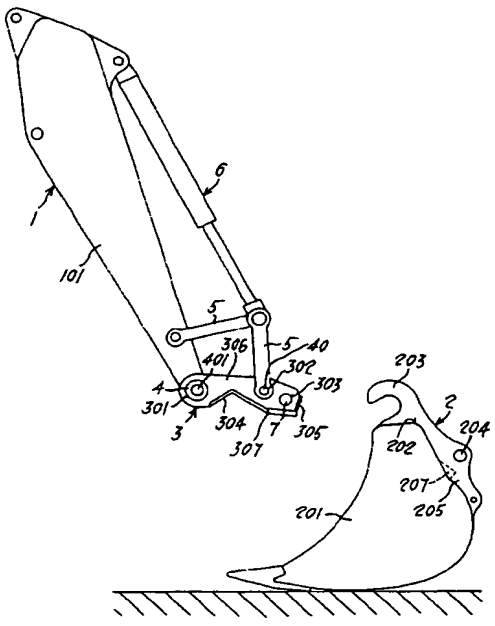

Fig. 1

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Description

[0001] The present invention relates to a quick-coupling and changing device for attaching tools, such as buckets, hammers, ripper teeth and so forth, to an excavator.

[0002] In view of the fact that the conventional process of connecting (without quick couplings) such tools to the arm of the excavator has the inconvenience that a lot of time is required to change such tools, and in many cases necessitates the involvement of workshops or at any rate more than a few workers, the present invention provides a quick-coupling device that allows tools to be changed almost immediately.

[0003] The feature that differentiates it from known quick couplings is that although tool change-over is just as rapid, the mechanism devised by the maker of the machine for tools connected directly to the machine's arm (without quick couplings) is left unchanged, which means that the forces of the excavator are left unmodified.

[0004] Another feature which differentiates it from other quick couplings is the system that continuously eliminates the points of play that develop between quick coupling and tool as a result of the wear occasioned by use.

[0005] The subject of the present invention is therefore a quick-coupling device for attaching a tool to the arm of an excavator: this device comprises a main body provided with at least two side walls each connected at the rear to this working arm by two first pins to allow it to be rotated relative to this arm and at the front to upper walls of the abovementioned tool by two second pins for attaching them to this tool; and these second pins are able to extend out of these side walls and be housed in holes formed in these upper walls of the tool under the action of control means mounted in the abovementioned housing for automatically inserting and removing them into and from the abovementioned holes, these upper walls being provided with rear hook means for attaching the tool to two pins concentric with the centre of rotation of the main body of the device.

[0006] The present automatic coupling device thus enables the operator of the excavator to carry out the work in much shorter cycle times, with greater efficiency, speed and convenience, especially owing to the dramatic shortening of the down times necessary for changing conventional tools.

[0007] Other objects and advantages of the present invention will become clearer in the course of the following description, viewed as illustrative and non-restrictive, which refers to the accompanying drawings in which:

Fig. 1 illustrates schematically a main arm of an excavator and a bucket waiting to be attached to this arm by a coupling device according to the present invention;

Fig. 2 illustrates the bucket of Fig. 1 attached to the main arm of the excavator with the aid of the present device;

Fig. 3 is a partial top view in section of the coupling device of Fig. 1 fitted with safety springs and a hydraulic cylinder containing pistons for inserting two securing pins into the bucket;

Fig. 4 is an enlarged top view in section showing the hydraulic cylinder and a first alternative embodiment of the safety springs;

Fig. 5 is a view of a second alternative embodiment of the safety springs, and

Figs 6a, 6b and 6c are three partial views of an alternative embodiment of the bucket securing pins and of the safety springs at three different stages of their working phases.

[0008] Referring to Fig. 1, this illustrates a main arm 1 of an excavator and a bucket 2 for excavating operations, waiting to be attached to the pins 4 of the main body 3 of the quick-coupling device according to the present invention. This device comprises a body 3 consisting essentially of two side walls 306 and a lower wall 304. These side walls 306 and this lower wall 304 consist of suitably shaped plates. Three pairs of through holes 301, 302, 303 are formed in these plates 306: when a pin 401 is inserted into the two holes 301 the body 3 is attached at the rear in such a way that it can rotate on the ends of the main arm 1; the two holes 302 allow the present device to be connected to a hydraulic operating system comprising on each lateral plate 101 a pair of levers 5 hinged to a hydraulic cylinder 6, which is controlled by an operator inside the excavator. The lower lever 5 is connected to these plates 306 by a pin 40 inserted through the said holes 302. The function of this hydraulic cylinder 6 is to raise and lower the body of the device 3 and hence the bucket 2, once attached to the device; while the side plates 306 have two holes 303 at the forward end, through each of which a pin 7 can extend and engage, as will be described later, in a hole 204 in each of two upper walls 205 of the bucket 2. This bucket 2 also includes a structure 201 whose upper box 202 is shaped in such a way as to fit, when attached, the lower plate 304 of the body 3, which is as stated suitably shaped. On the said upper walls 205 of the bucket 2 are two means 203 of attachment to the side pins 4 of the main arm 1 of the excavator. Also to be noted is the presence of a strengthening means 305 positioned at the forward end and crossways relative to the side plates 306.

[0009] Shown in Fig. 2 is the bucket 2 as attached to the main arm 1 of the excavator, a configuration which is arrived at after a series of operations in which the main body 3 of the device is rotated upwards about the pin 401 by the operator operating the hydraulic cylinders 6: this facilitates the insertion of these pins 4 into the attachment means 203, the distance between which also ensures that the said body 3 has plenty of room in the vertical direction for its insertion. After the pins 4 have

been inserted into the attachment means 203 the main arm 1 is raised upwards in the direction of arrow A as far as the situation illustrated in the figure and the body 3 is rotated downwards in the direction of arrow B so that another plate 307 on the underside of the said body 3 bears on a stop 207 on the upper box 202 of the bucket 2; it will be seen that the downward rotation of the said body 3 assists and completes the alignment of the pins 7 with the attachment holes 204 because of the pressure of this lower plate 307 on the stop 207. Following completion of these operations of insertion of the pins 4 and rotation of the coupling device, an operation to insert the rear pins 7 into the holes 204 of the two upper walls 205 of the bucket 2 begins.

[0010] The insertion of the pins 7 into the holes 204 in the upper walls 205 of the bucket 2 is illustrated in cross section in Fig. 3. This cross section illustrates both positions of the pins 7, i.e. before insertion into the holes 204 (pin 7' on the left) and after insertion (pin 7" on the right). This insertion is controlled by the operator and effected by means of a hydraulic cylinder 8 in which are two pistons 9, each with a rod 10 and these rods 10 extend from the end walls 801 of the cylinder 8 via through holes 802. It is on the outer ends of these rods 10 that the inner ends of the pins 7' and 7" are mounted via a supporting disc 11 that fits between two specially shaped plates 12 and is fastened to them by a rod 13. The figure illustrates the upper plates 12, more of which later in the following figures. The pins 7' and 7", as can be seen, comprise a first, more inward cylindrical part 701 which fits through the hole 303 in the corresponding side plate 306, and a more outward part 702 on which is formed a bevel designed to slide over a flat 206 formed in the hole 204 of the upper walls 205 of the bucket 2. The coupling of this bevelled part 702 to the corresponding flat 206 ensures progressive self-alignment as the pins 7 go in, great precision in the attachment and, in the very severe working conditions of the excavator, enhanced coupling between the side plates 306 of the coupling device and the bucket 2, because during these phases the bucket 2 tends to compress against the coupling device and the pins 7, because of the bevelled part 702, can advance further, so increasing, as stated, the coupling between the side plates 306 and the bucket 2: besides this, this solution is capable of absorbing any play created by the wear of parts in contact. Turning to the cylinder 8, this comprises a side wall 803 containing three holes 804, 805, 806 for the admission of a hydraulic fluid into the chamber: the central hole 805 acts on the faces of the pistons 9 so as to push the rods 10 and hence the pins 7 into the holes 204 (see pin 7"), while the side holes 804 and 806 act on the backs of the pistons 9 to withdraw the pins 7 from the said holes 204 (see pin 7'). The pressurized hydraulic fluid required to carry out these operations of inserting or removing the pins 7 is supplied to the cylinder 8 via a known hydraulic circuit by means controlled by the operator. Withdrawing the pins 7 is naturally easier for this operator than inserting them as there are no difficulties of engagement which could occur in the insertion operation.

[0011] Besides the double-acting cylinder 8 for controlling the pins 7, the present device also includes safety means for locking the said pins 7 in the inserted position in the holes 204, as a precaution against failures such as loss of oil from the circuit. Staying with Fig. 3, this shows a first, highly schematic embodiment of two sets of springs 14, one set for each of the two pins 7. The springs are mounted around the cylinder 8, parallel with its longitudinal axis. Each spring 14 of each set belonging to one of the pins 7 is attached at one end to a support flange 15 connected to the relevant pin 7 and, at the other end, fits into a sleeve 16 attached to a support 17 provided around the side wall 803 of the cylinder 8. These springs 14 work in compression and ensure that, in the event of failure of the hydraulic circuit, the pins 7 do not come out of the holes 204 of the bucket 2. In particular in the case of the pin 7", the springs 14 are partially relaxed by the action of the hydraulic fluid which is simultaneously pushing this pin 7" into its hole 204. The springs 14 situated behind the pin 7', which is withdrawn from the upper wall 205, are however compressed by the action of the fluid acting on the back of the corresponding piston 9.

[0012] Fig. 4 shows a first alternative embodiment of the safety springs. As can be seen, the springs 14 are housed at one end in a cup 18 to which a sleeve 19 is fixed, while at the other end they are fixed in a seat 20 recessed into the flanges 15. These flanges 15 are attached to the inner edge of the cylindrical part 701 of the pins 7 with coupling means 21, such as pins, bolts or the like. Each cup 18 is attached on the outside to a bolt 22 fitted with a nut 23 and engaged in a tapped hole formed in each support 17. By turning the bolts 22 it is possible to adjust the precompression of the springs 14. In the case of the pin 7', which is withdrawn with its springs 14 compressed, the sleeve 19 of each spring has passed into a jacket 24 attached to the flange 15, ensuring good maintenance of the alignment of the said pin 7' during the operations of inserting it into the hole 204. In the case of the inserted pin 7", the sleeve 19 may perhaps come a short way out of the said jacket 24, with the spring 14 partially relaxed. As mentioned earlier, this figure also shows the special shaping and the flats of the plates 12 which are fastened by a rod 13 to the disc 11 housed between them.

[0013] The previous figs. illustrated the case in which two sets of springs 14 are provided, one set for each of the pins 7, the springs being attached between the two flanges and two sets of supports 17. Shown in Fig. 5 is an alternative embodiment using a single set of springs 25 arranged around the side wall 803 of the cylinder 8 and parallel to the two rods 10. In this version each spring 25 is placed inside a sleeve 29 that can slide inside a jacket 30. This jacket 30 is attached to one of the two flanges 15 connected to one of the pins 7, in this

case the upper flange 15 in the figure, while the sleeve 29 is attached to the inner side of a support 26 through which passes a tapped hole carrying a bolt 27 for adjusting the compression of the spring 25: this bolt is provided with a nut 28 butted against the outer side of the said support 26 and is attached to the other flange 15 connected to the other pin 7, in this case the lower flange 15 in the figure. Telescopic sliding of the sleeve 29 inside the jacket 30 gives constant protection to the spring 25 and at the same time precise alignment during the operations of inserting and removing the pins 7. In the situation illustrated, the sleeves 29 are partly out of the jackets 30 because the pins 7 have been fully inserted into their respective holes 204 by the action of the pressurized fluid which has entered the central admission hole 805 of the cylinder 8 and has acted on the faces of the two pistons 9. When it comes to the withdrawal operation, the fluid enters via the side admission holes 804 and 806 and will push on the backs of the pistons 9 in such a way as to pull the pins 7 in and increase the overlap between the jackets 30 and the sleeves 29.

[0014] Fig. 6a illustrates an alternative embodiment of the pin 7 and of the safety means which ensure its insertion into the hole 204 in the bucket 2 in the event of failure of the hydraulic circuit. Formed in the inner face of the cylindrical part 701 of the pin 7 is a cylindrical seat 703 into which fits a cup 31 housing one end of a spring 32, the other end of which is in abutment against the base of the cylindrical seat 703. This cup 31 is connected to the outer end of the rod 10 of the cylinder 8 by a bolt 33 comprising a threaded portion 34 and a head 35 of larger cross section on its inside end. This head 35 is housed inside a hole 704 running in from the outside of the bevelled part 702 of the pin 7 and terminating close to the base of the cylindrical seat 703, leaving a portion in which a hole 705 is formed in which a portion of the bolt 33 close to the said head 35 can slide. The threaded portion 34 passes through a first tapped hole 37 formed in the base of the cup 31 and passes into a second tapped hole 36 running in from the outer end of the rod 10 and in axis with the hole 704. On this threaded portion 34 are two nuts 38 and 39 for adjusting the compression of the spring 32, the nut 38 butting against the base of the cup 31 and the nut 39 against the outer surface of the rod 10. With this variant the safety means (the spring 32) of the coupling device can therefore be inserted into the pin 7 itself, coaxially therewith, thus avoiding the use of springs arranged around the cylinder 8 as in the previous cases. It should be observed that two or more coaxial springs of different sizes could be housed between the cup 31 and the cylindrical seat 703.

[0015] Examination of Figs 6b and 6c together with Fig. 6a will reveal the operation of the device when inserting the pin 7 in this alternative embodiment. When the operator sends pressurized fluid into the cylinder 8 the rod 10 begins to extend from the said cylinder and push the pin 7 connected to it along the hole 303 of the side plate 3 until it is fully into the hole 204 of the upper wall 205 of the bucket 2. The pin 7 reaches the situation of Fig. 6b, in which therefore the rod 10, the cup 31, the spring 32, the bolt 33 and the pin 7 have moved as if all one rigid body. At the end of this first phase of insertion of the pin 7, further pressure on the pistons brings about a relative movement of the cup 31 with respect to the pin 7, in particular (see Fig. 6c) this cup 31 pushes into the cylindrical seat 703, compressing the spring 32 and pushing the bolt 33 along inside the hole 704, as is clear from the position of the head 35 illustrated in Fig. 6c. In the event of failure of pressure in the hydraulic circuit, the rod retracts downwards (when viewing the figure), taking with it the bolt 33 until the head 35 butts against the bottom of the hole 704, the cup 35 comes out of the cylindrical seat 703 again and the spring 32 partly relaxes. During this series of movements brought about by the return of the rod 10, the pin 7 advantageously remains locked in position inside the hole 204. To remove the pin 7, e.g. if the bucket is to be changed for another tool, fluid must be supplied to the side admission holes described earlier of the cylinder 8 and the rod 10 retracted so that it first places the head 35 of the bolt 33 in abutment against the bottom of the hole 704 and then, by virtue of this abutment, pulls in the pin 7.

[0016] The present quick-coupling device for an excavator is therefore characterized by many advantages including: no modification of any kind to the original mechanism and features of the excavator to which it is applied, the machine's original pins 401 and 40 being used and no alteration being made to the centres of rotation of the various parts, the working distances and so forth, so that the original efficiency of the machine is unaltered; quick and simple attachment/detachment of the various tools to and from the main arm, with generous lead-in bevelling to facilitate engagement, both horizontally and vertically; an efficient mechanism of progressive self-insertion enabling penetration and forced locking of tools; a high degree of safety against the risk of failure of pressure of the hydraulic fluid, by means of the various springs described; and extreme mechanical robustness, allowing the use of tools such as drills or the like which severely stress the arms of the excavator.

Claims

1. Quick-coupling device for attaching a tool (2) to an excavator comprising at least one main working arm (1), **characterized in that** it comprises a main body (3) provided with two side walls (306) each connected at the rear to the said working arm (1) by a pin (401) housed in holes (301) in the said walls (306) to allow it to be rotated relative to the said arm (1) by the movement of excavator levers (5) connected to the body (3) by a pin (40) housed in holes (302) in the said walls (306) and at the front to upper walls (205) of the said tool (2) by second pins (7) for locking them onto the said tool (2), the said sec-

ond pins (7) being able to extend out of the said side walls (306) and be housed in holes (204) formed in the said upper walls (205) of the tool (2) under the action of control means (8) mounted in the said body (3) for automatically inserting and removing them into and from the said holes (204), and the said upper walls (205) being provided with rear hook means (203) for attaching the tool (2) to pins (4).

2. Coupling device according to Claim 1, **characterized in that** the said control means comprise at least one cylinder (8) in which one or two pistons (9) slide in opposite directions, the said cylinder (8) being provided with admission holes (804, 805, 806) for a fluid for operating the said pistons (9), the pistons (9) projecting from the end walls (801) of the cylinder and being connected by suitable means (10, 11, 12, 13) to the said second pins (7).

3. Coupling device according to Claim 2, **characterized in that** the said second pins (7) comprise mechanical means (14, 25, 32) for locking them if necessary in their holes (204) in the tool (2).

4. Coupling device according to Claim 3, **characterized in that** the said locking means are elastic means (14, 25, 32).

5. Coupling device according to Claim 3, **characterized in that** the body (3) comprises a set of supports (17) for the cylinder (8), and a first end of a spring (14) is attached to each of these supports, the second end of each spring being attached to a flange (15) connected to the respective pin (7), the said springs (14) being positioned parallel to the said side wall (803) of the cylinder (8).

6. Coupling device according to Claim 5, **characterized in that** the said first ends of the springs (14) are mounted inside sleeves (16) attached to the said supports (17) provided in the body (3) of the device.

7. Coupling device according to Claim 5, **characterized in that** the said supports (17) comprise a bolt (22) for adjusting the tension of the spring (14), a more inward end of the said bolt (22) being inserted in a corresponding tapped hole provided in each of the said supports (17) and a more outward end of the said bolt (22) being attached to a support (18) for the said first end of the spring (14).

8. Coupling device according to Claim 7, **characterized in that** the said support is in the form of a cup (18) in which the said first end of the spring (14) is inserted and onto which is fitted a sleeve (19), the said second end of the spring (14) being inserted into a jacket (24) attached to an inner side of the flange (15).

9. Coupling device according to Claim 3, **characterized in that** a set of springs (25) arranged around the cylinder (8) and parallel with its side wall (803) are attached between the flanges (15) connected to the pins (7).

10. Coupling device according to Claim 9, **characterized in that** the said springs (25) comprise, for adjusting their tension, bolts (27) connected to the said flanges (15) and to supports (26) for the said springs (15).

11. Coupling device according to Claim 9, **characterized in that** the said springs (25) are fully enclosed in a jacket (30) and in a sleeve (29) that moves telescopically inside the said jacket (30), the said jacket (30) being attached to a respective flange (15) and the said sleeve (29) being connected to the said support (26) of each spring (25).

12. Coupling device according to Claim 1, **characterized in that** the said pin (7) consists of a more inward cylindrical part (701) and a more outward part (702) on which a bevel is formed, the said bevel being designed to mate with a corresponding flat (206) formed in the insertion hole (204) situated on the upper wall (205) of the tool (2).

13. Coupling device according to Claim 7, **characterized in that** the piston (9) comprises a rod (10) on whose more outward end is a disc (11) designed to be inserted between two suitably shaped plates (12) connected to the flange (15), the said disc (11) and the said plates (12) being clamped together by a rod (13) or pin.

14. Coupling device according to Claim 4, **characterized in that** the said elastic means consist of one or more springs (32) coaxial with the pin (7) and housed at one end in a seat (703) running in from the more inward end of the pin (7) and at the other end in the base of a cup (31) that slides in the said seat (703) and is integral with a respective piston (9) moving inside the cylinder (8).

15. Coupling device according to Claim 14, **characterized in that** coaxially with the said spring (32) inside the pin (7) is a bolt (33) comprising a threaded portion (34) and a head (35) of larger cross section, the said bolt (33) engaging in holes (37, 36) formed respectively in the base of the cup (31) and on the more outward end of the rod (10) of the piston (9), and the head (35) of the bolt (33) sliding in a first hole (704) running in from the more outward end of the pin (7), the head (35) abutting against the walls

of a second hole (705) of smaller cross section coaxial with the said first hole (704).

16. Coupling device according to Claim 1, **characterized in that** it comprises a lower plate (307) attached to the two side walls (306) or plates and shaped in such a way so as to rest on at least one suitably shaped stop (207) on the tool (2).

17. Coupling device according to Claim 1, **characterized in that** the said side plates (3) comprise at the front a strengthening member (305) running transversely to these plates.

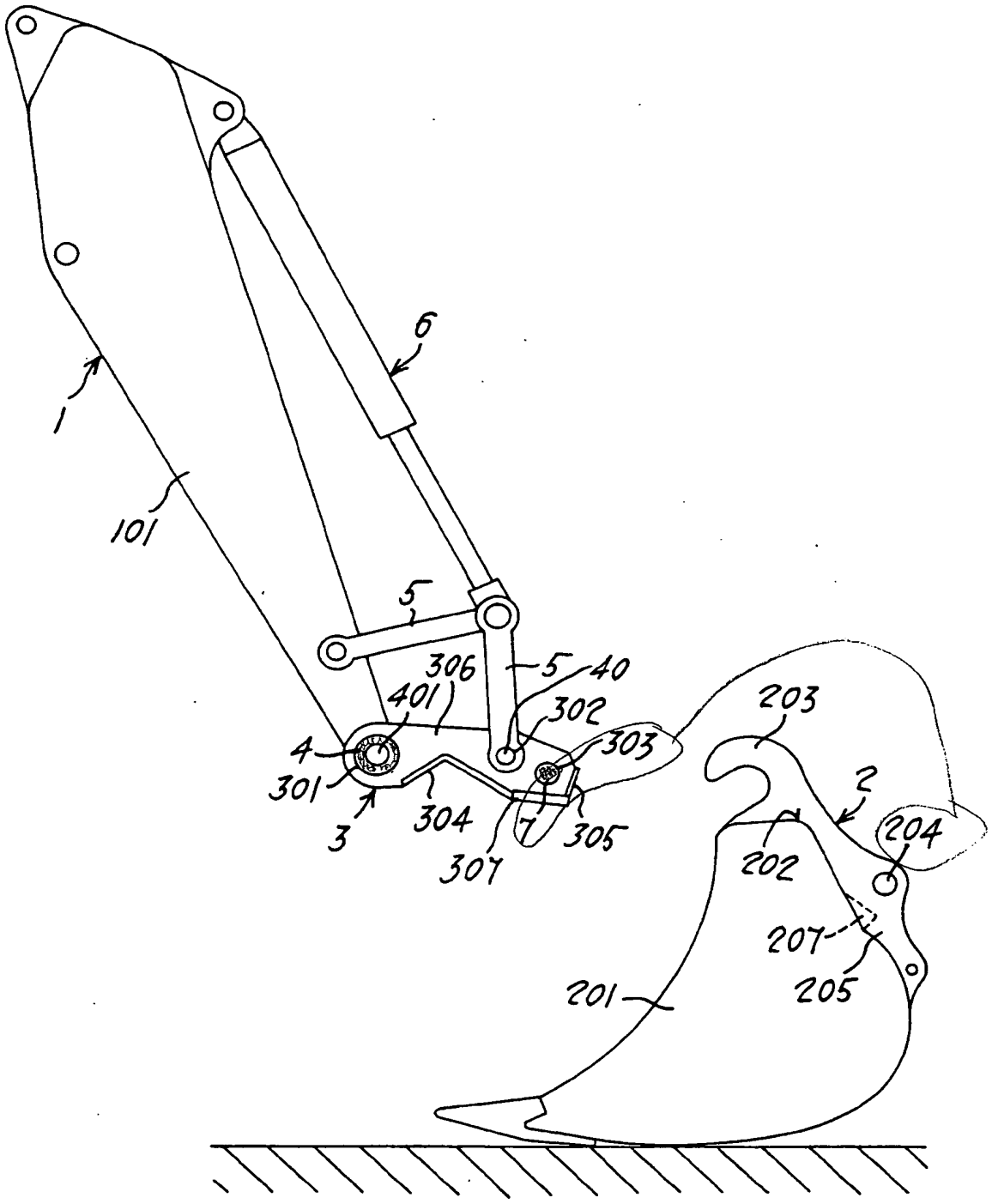


Fig. 1

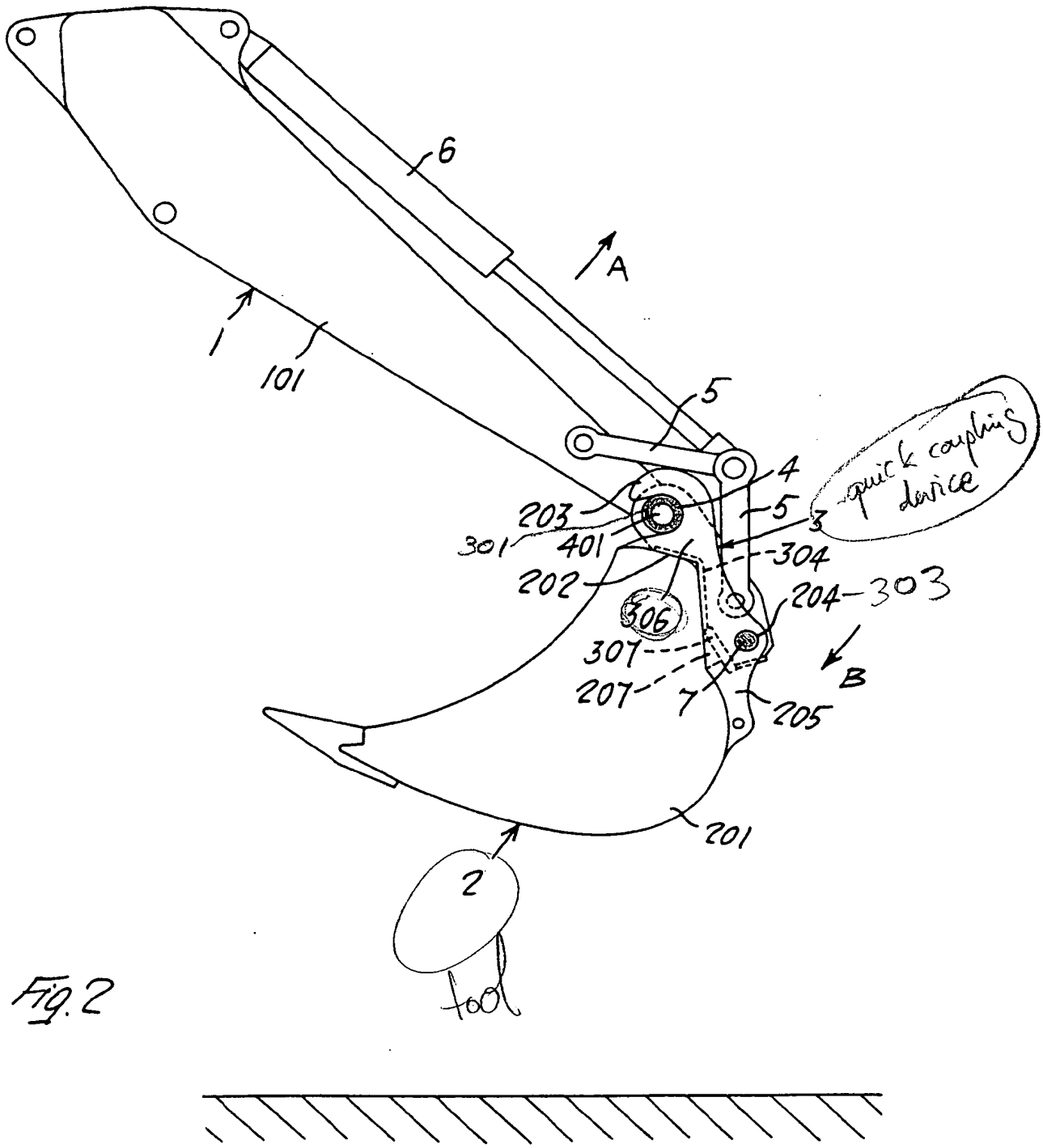


Fig. 2

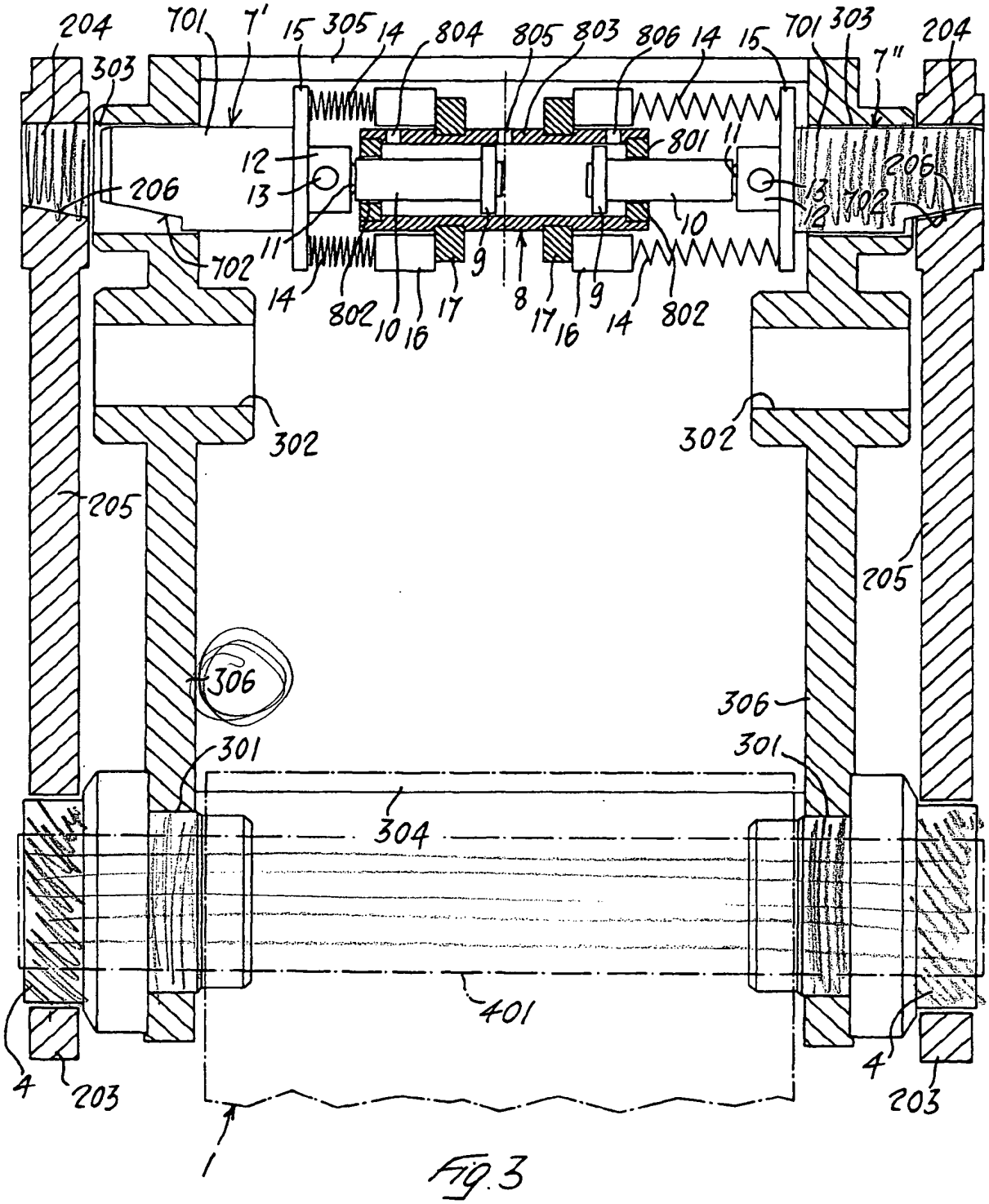


Fig. 3

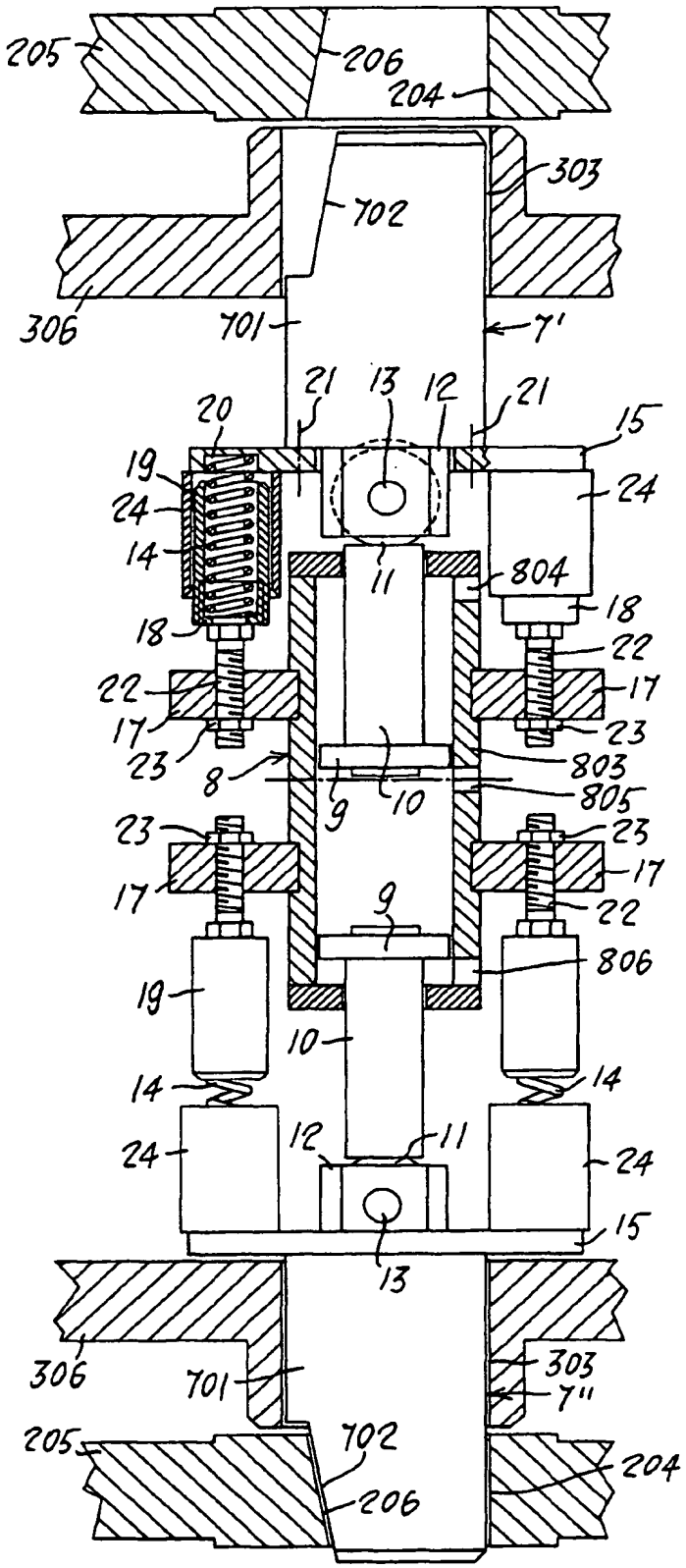


Fig.4

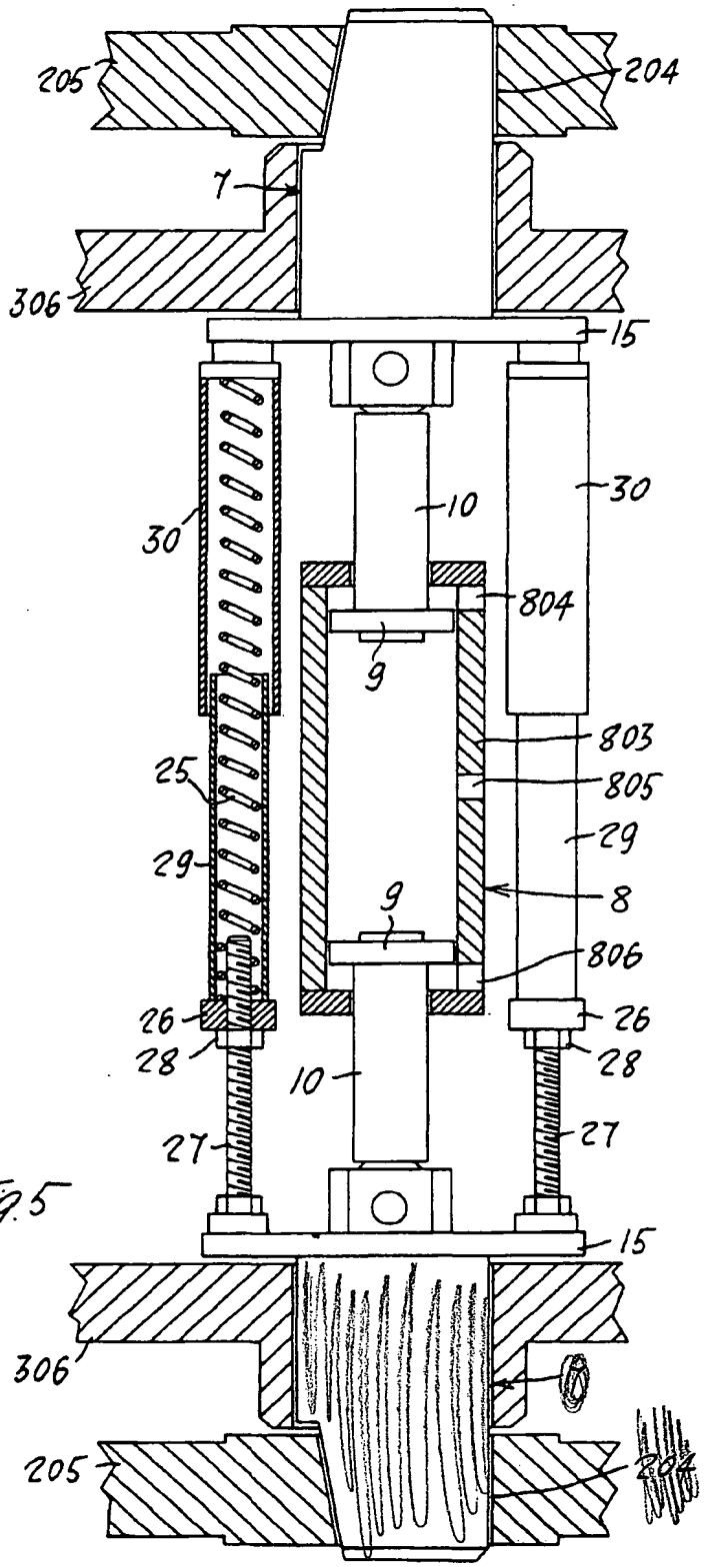
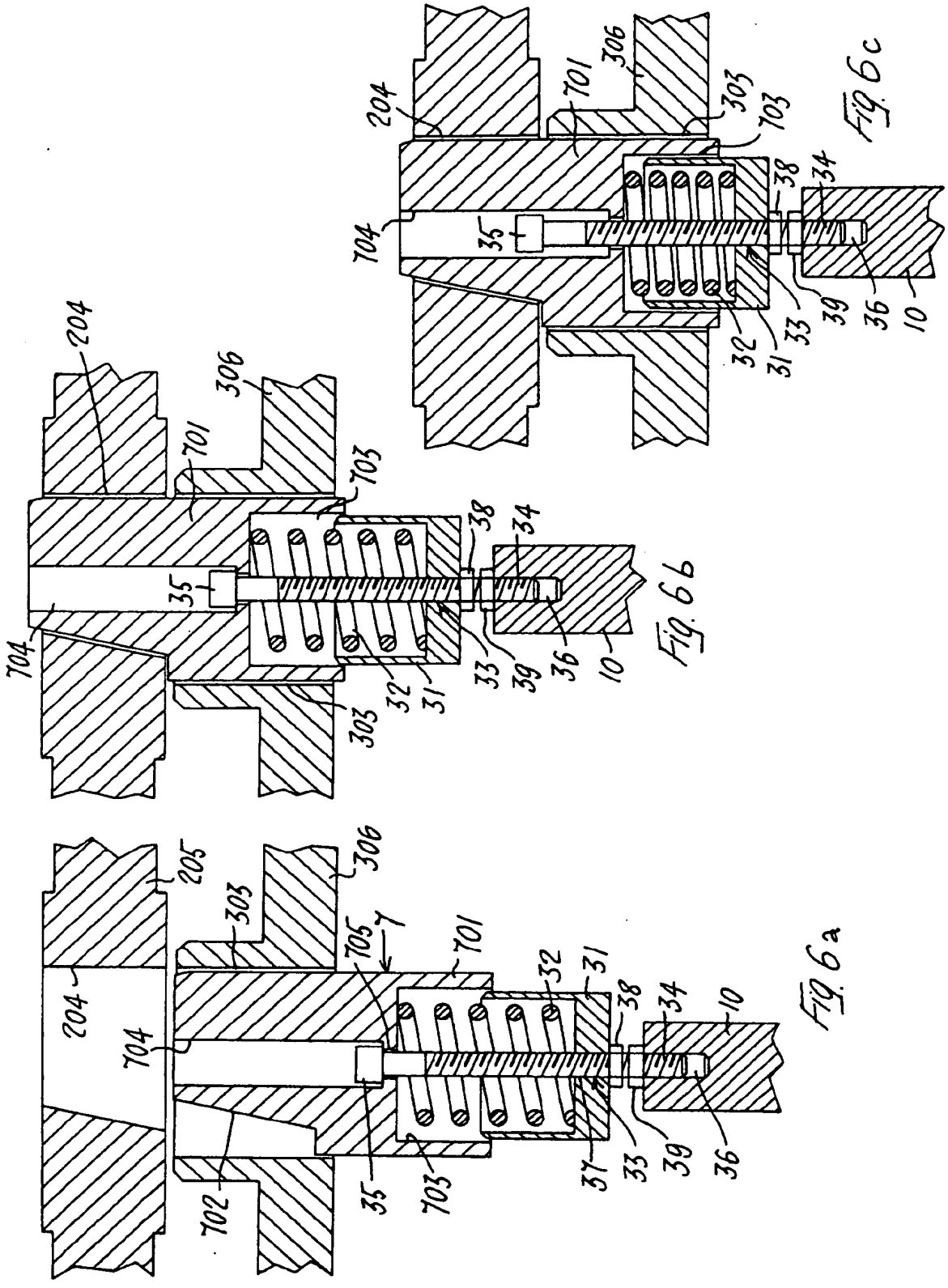


Fig. 5



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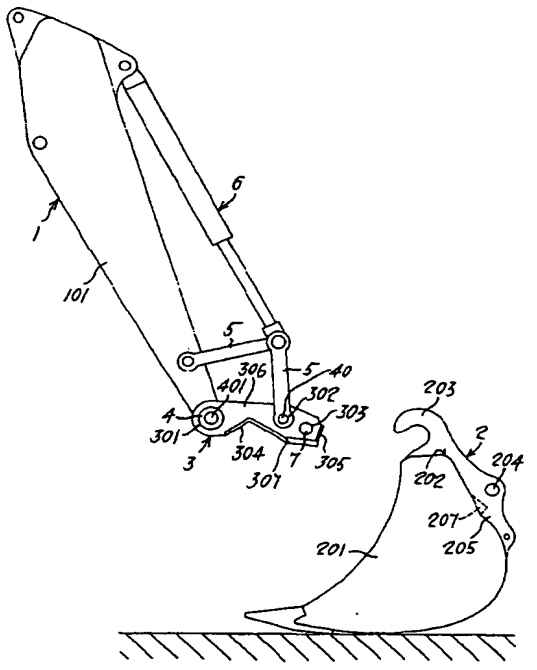

Fig. 1

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 11 0830

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 315 (M-0995), 6 July 1990 (1990-07-06) -& JP 02 104824 A (TAKAYUKI TAKAHASHI), 17 April 1990 (1990-04-17)	1,2	E02F3/36
Y	* abstract; figures 1-3 *	3-13,16,17	
Y	US 5 546 683 A (CLARK GEORGE J) 20 August 1996 (1996-08-20) * column 6, line 6 - column 7, line 16; figures *	3-11	
Y	US 5 024 010 A (HULDEN FRITIOF) 18 June 1991 (1991-06-18) * column 5, line 46 - column 6, line 21; figures *	12,13,16,17	
A	DE 196 51 507 A (SAMSUNG HEAVY IND) 3 July 1997 (1997-07-03)		

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	4 June 2002	Laurer, M

CATEGORY OF CITED DOCUMENTS

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